

Message

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Sent: 9/15/2017 7:28:22 AM
To: CUBBAGE, JERRY W [AG/1000] [jerry.w.cubbage@monsanto.com]
Subject: humidome learnings
Attachments: Humidome-lights-rev2.docx

Jerry,

I have shared this with a few people, but I think I should share it with you also. The attached file describes some recent learnings with respect to our humidome testing. More importantly, I think it provides some insight into how we can improve our dicamba formulations with respect to volatility. Please look over the document and then I would like to discuss it with you. Thanks.

Walter

BADER FARMS ET AL v. MONSANTO ET AL.

EXHIBIT
PLTF-130

Highly Confidential

MON0230591

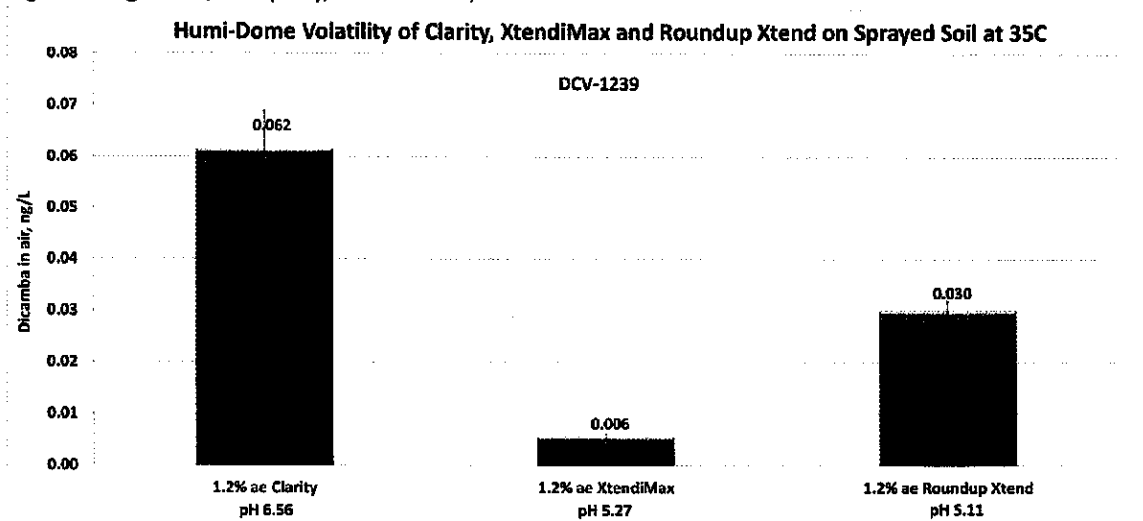
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Light effect on humidome testing

During the Creve Coeur (CC) humidome testing the 14 hour day / 10 hour night light cycle has typically been used (light intensity of 100 to 140 μ moles per square meter per second). Since there is limited control of these lights, they have been used as-is. Recently, we have been working to migrate the humidome testing to the Chesterfield (CV) site and to the Battelle contract lab. In each case, the lighting in the growth chamber was different than in the CC chambers.

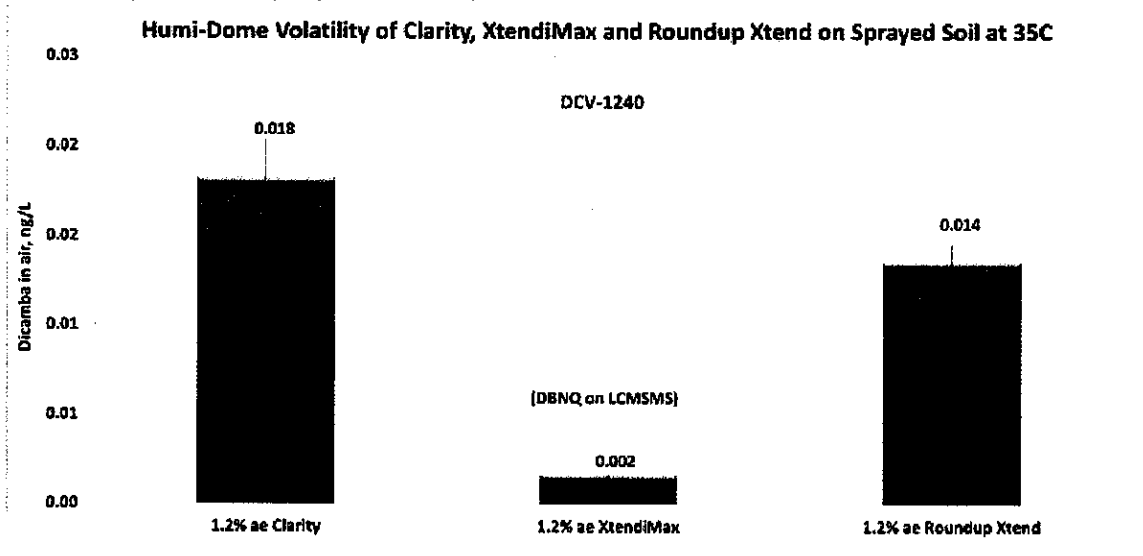
Typically, Clarity has 2x to 3x greater volatility than Xtend. An example of this is in Figure 1.

Figure 1. Lights on, 35C (95F), 24 hour test, CC chambers



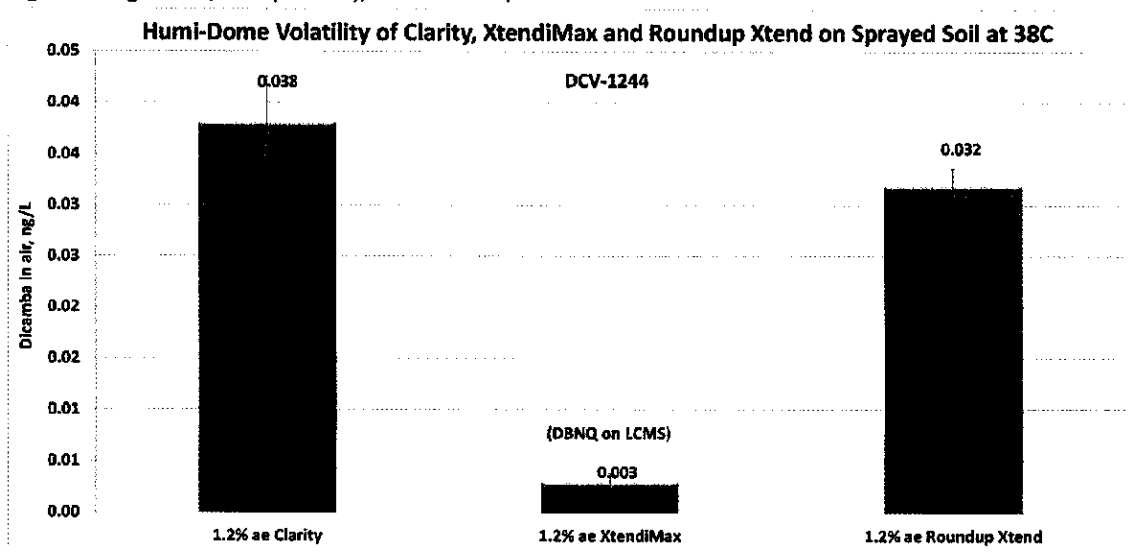
In the CV chamber, the intensity of the lights was too strong and condensation in the vacuum lines was observed after one hour of operation. In order to avoid the condensation problem, the lights in the chamber were turned off. Figure 2 is an example of data generated at CV with the chamber lights off.

Figure 2. Lights off, 35C (95F), 24 hour test, CV chamber



Note that with lights off, Clarity is only slightly higher in volatility than Xtend. An experiment was run at 38C to determine if the increase in temperature would restore the volatility difference between Clarity and Xtend. Figure 3 contains the results of the experiment.

Figure 3. Lights off, 38C (100.4F), 24 hour test, CV chambers



While the increase in temperature resulted in an increase in the amount of dicamba that was seen, it did not change the relative volatility of Clarity and Xtend. This would indicate that the lighting has an effect on the relative volatility.

Battelle had reported similar results and did a side by side comparison with and without lights. Figure 4 shows their data without lights and Figure 5 with lights.

Figure 4. Battelle test without lights

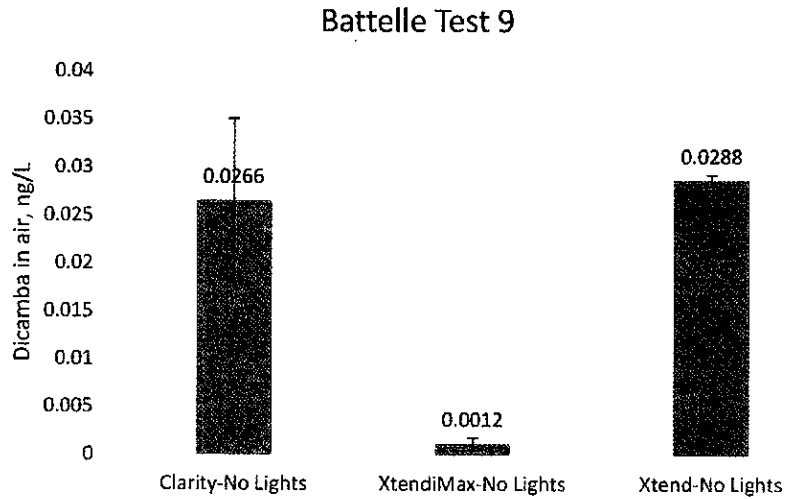


Figure 4. Battelle test with lights

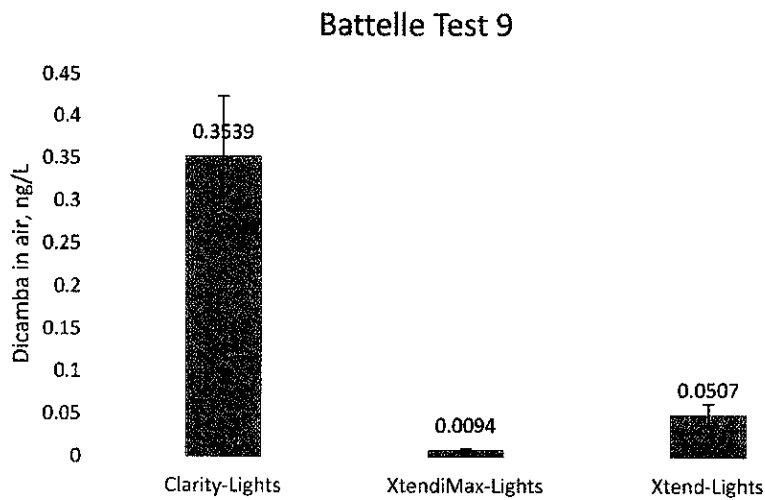
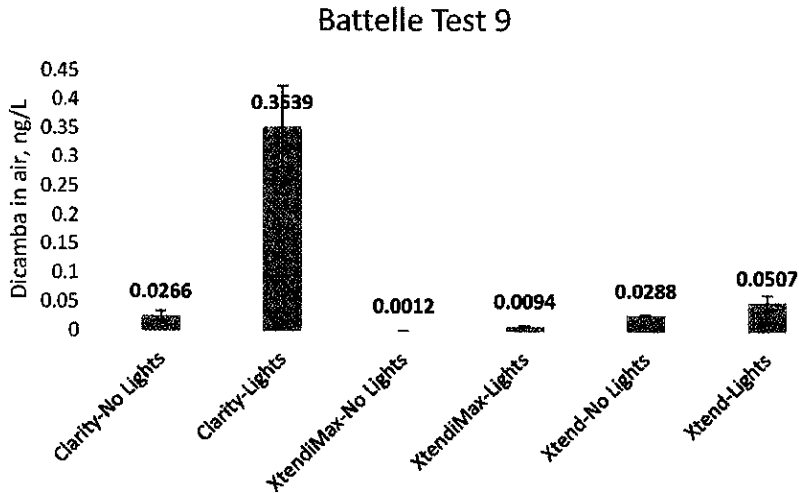


Figure 6. Data from Battelle Test 9 combined

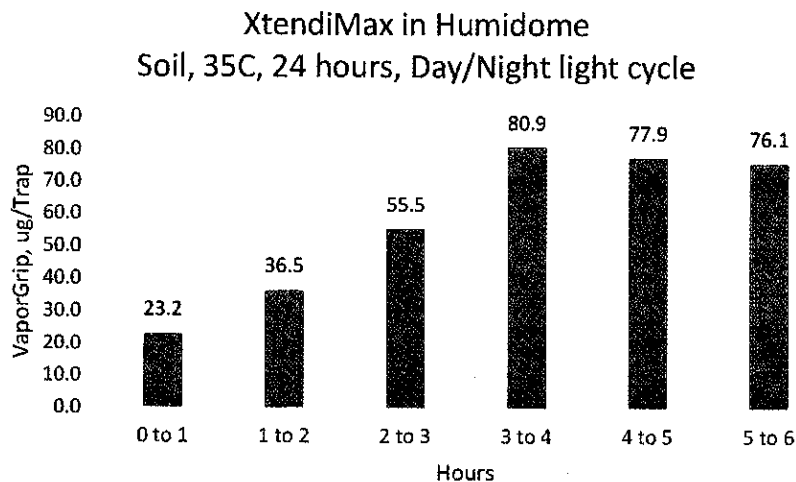


The Battelle experiments demonstrated a similar increase in volatility for Clarity vs Xtend as was seen in the CC and CV chambers. This may suggest that the intensity of the lights (think sitting in your car on a cold day with the sun shining and you start to get hot even though the temp outside the car is cold) impacts the volatility by volatilizing the counter ion of the dicamba salt. With the VaporGrip formulations you have the salt's counter ion and VaporGrip to help control the protonation of dicamba but with Clarity you only have the counter ion. This would explain why it is effected more than the VaporGrip formulations. To further explore this idea, we are conducting a 48 hour experiment with the lights off to determine if the effect is simply delayed without the lights.

Short term volatilization of dicamba and VaporGrip

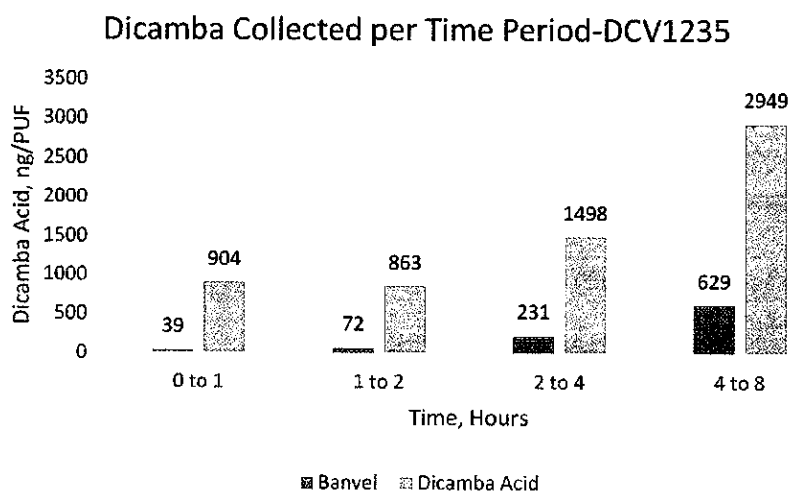
Experiments were done to try and understand the short term volatilization of VaporGrip and dicamba. Figure 7 shows data taken over a six hour time period. XtendiMax was sprayed on soil in a humidome and placed in a CC chamber. The data show how much VaporGrip was collected during each of the indicated time periods. The first three time periods show that the volatilization of VaporGrip is increasing before leveling off at the three hour mark.

Figure 7. Monitoring VaporGrip volatility



Since the dicamba concentration for XtendiMax is below the detection limits of the analytical method in the early time points for the the humidome method, Banvel and dicamba acid were used to try and understand the early dicamba volatility profile. Figure 8 contains those results.

Figure 8. Early time point humidome data



The results indicate that the volatility is somewhat constant for the first two hours before starting to increase. This is similar to what was seen for VaporGrip and is perhaps an indication that it takes some time for the lights to heat up the soil and accelerate volatility.

Longer term volatility evaluation

Data from a 72 hour test were re-examined. Figure 9 shows the amount of dicamba that was detected during each of the three 24-hour segments. Figures 10, 11, and 12 show the data plotted individually. The experiment was run in with the typical humidome experimental conditions.

Figure 9. 72 hour test

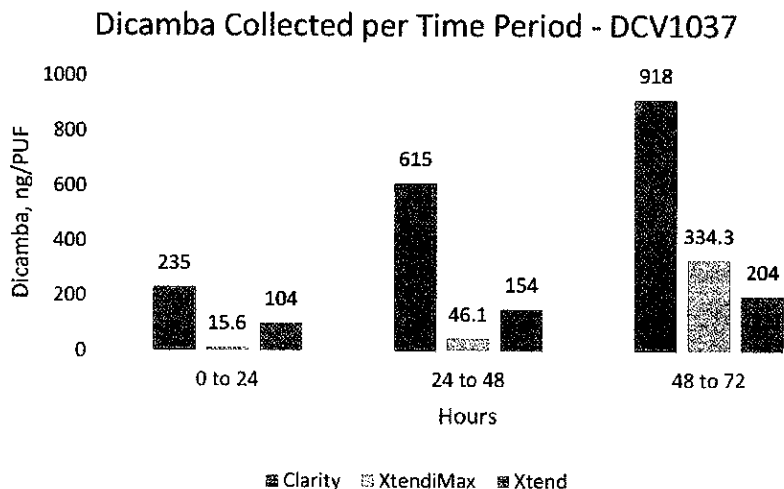


Figure 10. Clarity 72 hours

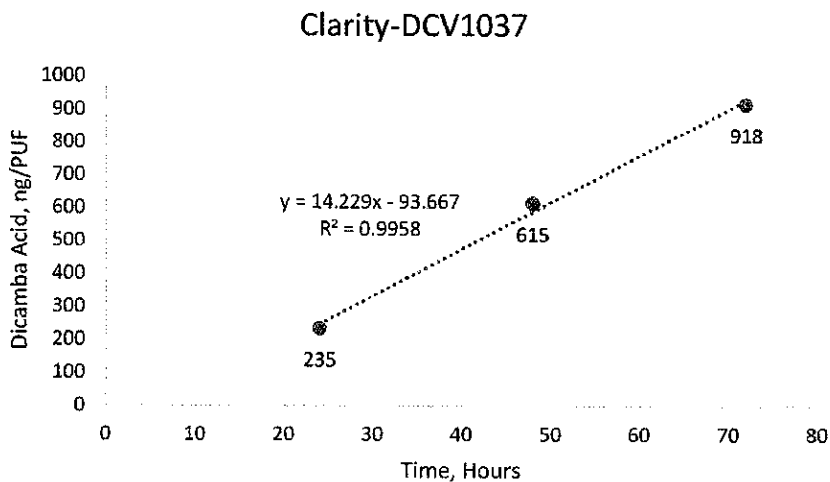


Figure 11. XtendiMax 72 hours

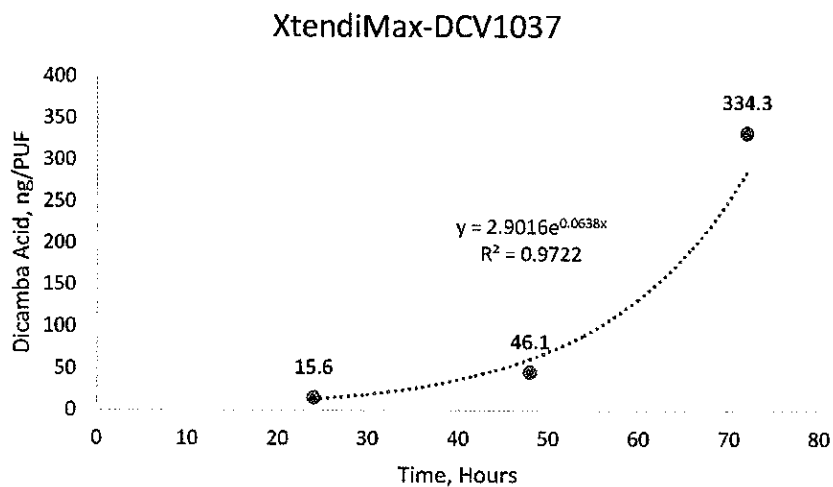
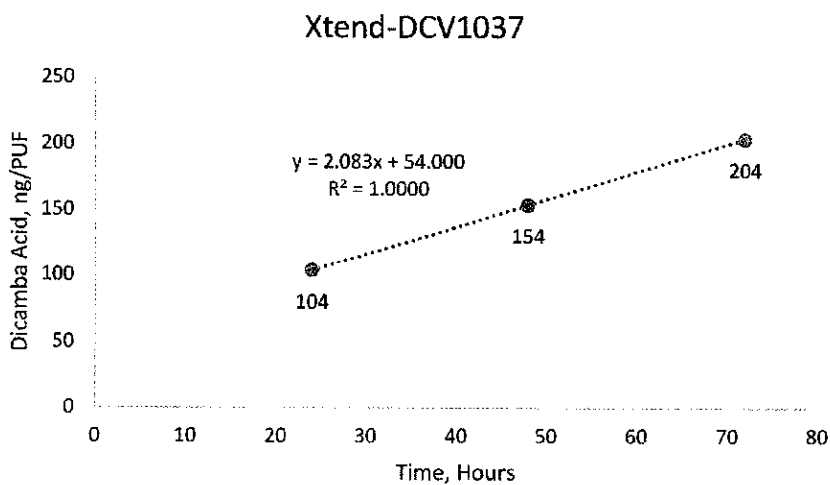


Figure 12. Xtend 72 hours



Xtend and Clarity demonstrate a linear increase in volatility over the 72 hour time period. The highest Xtend volatility value is lower than the lowest Clarity volatility value. XtendiMax has the lowest volatility for 48 hours and appears to be linear but then has a large increase at 72 hours. This may be an indication that the glyphosate buffered Xtend formulation has less volatility because of the buffer capacity vs XtendiMax which will have less buffer capacity and depends on VaporGrip to reduce volatility. Both VaporGrip formulations are substantially less volatile than Clarity at all time points.

96 Hour volatility evaluation

A 96 hour test was conducted. Figure 13 shows the amount of dicamba that was detected during each of the four 24-hour segments. Figure 14 shows the data plotted individually. The experiment was run in with the typical humidome experimental conditions.

Figure 13. 96 hour test

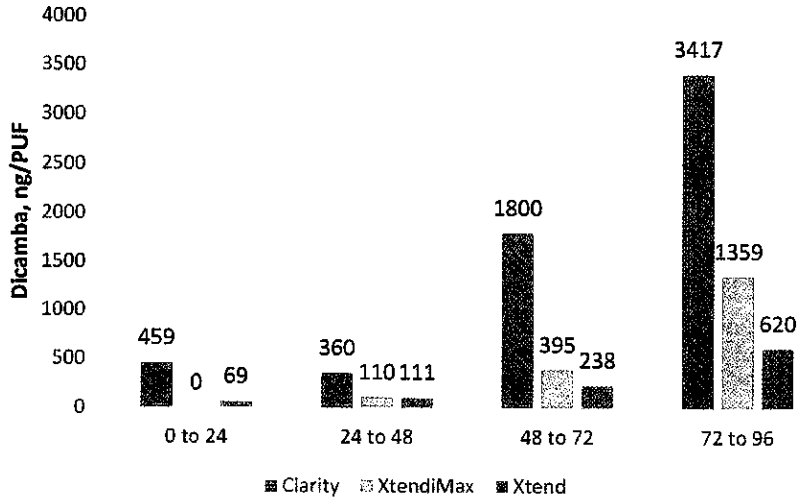


Figure 14. 96 hour test

